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ABSTRACT

This document defines the hardware interfaces for the Phased Array Communication Antenna System for Fairlines. Connectivity and the electrical characteristics of the interfaces between the system line replaceable units (LRUs) are documented.

KEY WORDS

Airplane
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ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ARINC	Aeronautical Radio, Inc.
AWG	American Wire Gauge
BSS	Broadcast Satellite Service
dB	Decibel
DC	Direct Current
EIA	Electronic Industries Association
GHz	Gigahertz
HP	Horizontal polarization
ICD	Interface Control Document
LHCP	Left-hand circular polarization
LNB	Low Noise Block
LP	Linear polarization
LPC	Linear Polarization Converter
LRU	Line Replaceable Unit
MHz	Megahertz
RF	Radio Frequency
RHCP	Right-hand circular polarization
RX	Receive
S	Source
TX	Transmit
VP	Vertical polarization
Ω	Ohms



1. GENERAL

This document applies to the phased array communication antenna system hardware interfaces.

1.1 Scope and Purpose

This interface control document (ICD) documents the connectivity and electrical characteristics of the interfaces between system line replaceable units (LRUs). The ICD content was developed to control the system inter-LRU electrical interfaces. The ICD information represents a design implementation that complies with the Phased Array Communication Antenna System for Fairlines Requirements Document (D909-80003-1). The system external interfaces (included for reference in section 4) and the physical/mechanical interfaces (size, weight, center of gravity, and mounting provisions) are controlled by the Phased Array Communication Antenna System for Fairlines Requirements Document.

1.2 Reference Documentation

<u>Document Number</u>	<u>Title</u>
D909-80003-1	Phased Array Communication Antenna System for Fairlines Requirements Document
S909-32005	Specification Control Drawing for Low-Noise Block/Down Converter
EIA Standard RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
EIA Standard RS-422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA Standard RS-485	Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems



2. SYSTEM INTERFACE INTERCONNECT DIAGRAM

An interconnect diagram is provided to show the system level connectivity for signals, power, and grounding. System LRUs are represented by solid lined boxes and external items are shown as dash lined boxes. Electrical and signal characteristics for system internal inter-LRU connections are further defined in section 3 of the ICD. System external interfaces are further defined in section 4 of the ICD.

Figure 2-1 shows the system interface connectivity including LRU and signal name identification, connector and pin definition, wire gauge (AWG), and system grounding.

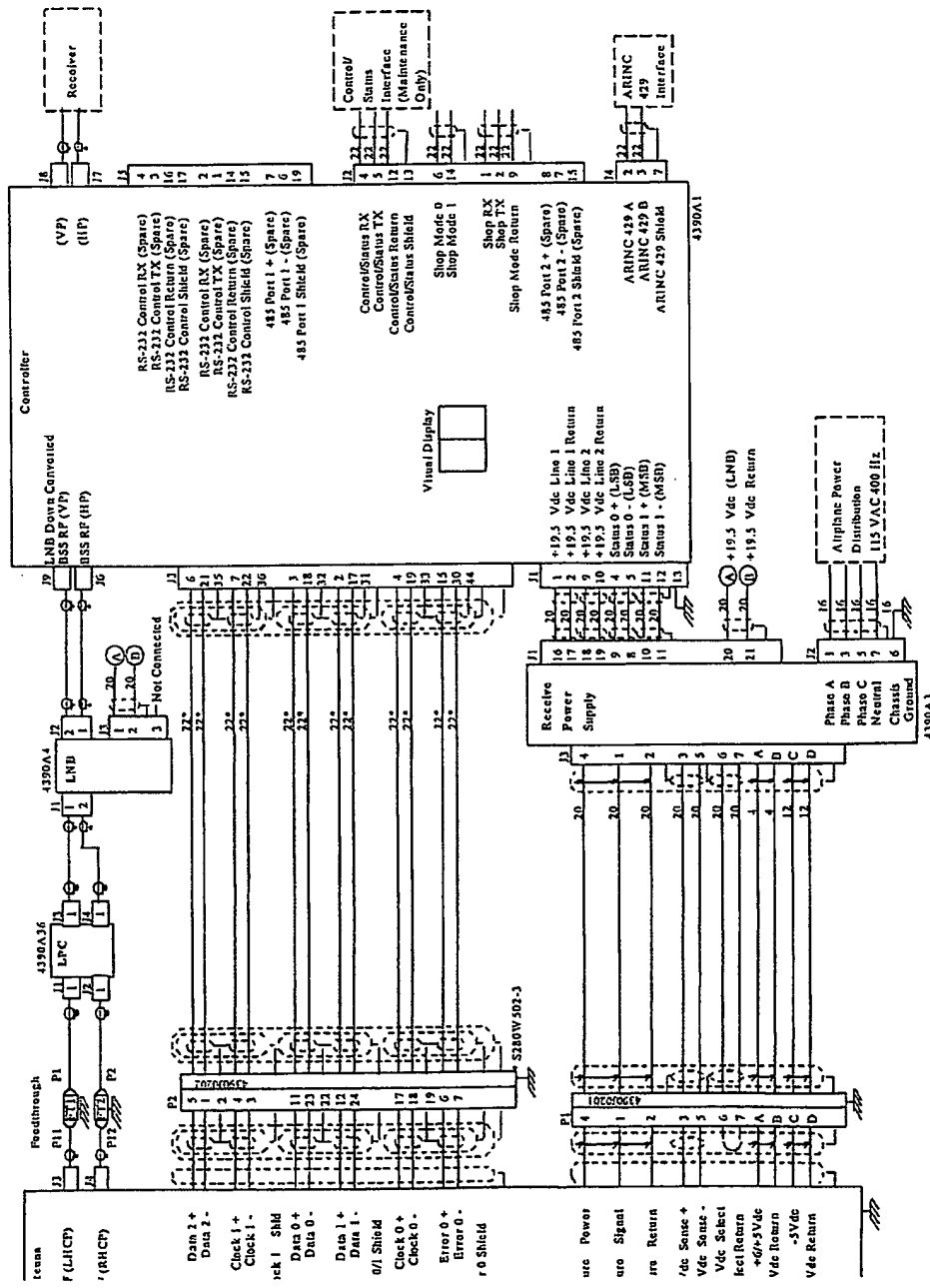


FIGURE 2-1. SYSTEM INTERFACE INTERCONNECT DIAGRAM - FAIRLINES CONFIGURATION

FIGURE 2-1 SYSTEM INTERFACE INTERCONNECT DIAGRAM - FAIRLINES CONFIGURATION



3. INTER-LRU CONNECTIVITY

The signal characteristics for the dual-polarization receive system inter-LRU connections are contained in the sections identified on Figure 3-1.

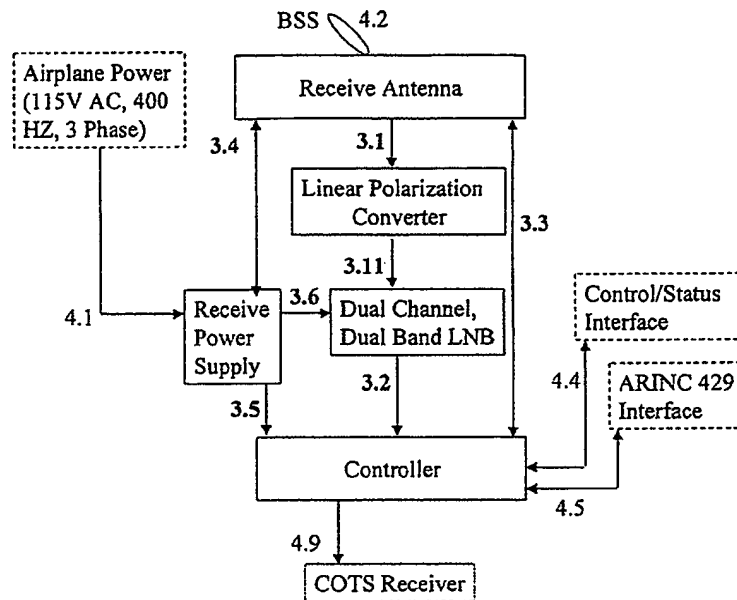


FIGURE 3-1 FAIRLINES SYSTEM INTER-LRU INTERFACE SECTIONS

Note that the "S" columns in the tables that follow stand for "Source" and a "✓" means that the adjacent LRU is the signal source for the associated signal identified by the "Signal Name".



The LRU connectors are as identified in Table 3-1.

TABLE 3-1 LRU CONNECTORS

4390A1 Controller	
J1	S906-70293-291 D-Sub DA15 (Pins)
J2	S906-70293-290 D-Sub DA15 (Sockets)
J3	S906-70293-289 D-Sub DB44 (Pins)
J4	S906-70293-293 D-Sub DE9 (Sockets)
J5	S906-70293-292 D-Sub DB25 (Sockets)
J6	TNC (Jack) per MIL-STD-348 (Keyed@162°)*
J7	TNC (Jack) per MIL-STD-348 (Keyed@42°)*
J8	TNC (Jack) per MIL-STD-348 (Keyed@102°)*
J9	TNC (Jack) per MIL-STD-348 (Keyed@222°)*
*Four gang keyed TNC connectors P/N K-4985 (Kings Electronics Co.)	

4390FT1 and FT2 Feedthrough	
	Kings Bulkhead Hermetic Seal 879-13-3 or equivalent

4390A36 Linear Polarization Converter	
J1	SMA (Jack w/socket contact) per MIL-STD-348 (input LHCP)
J2	SMA (Jack w/socket contact) per MIL-STD-348 (input RHCP)
J3	SMA (Jack w/socket contact) per MIL-STD-348 (output VP)
J4	SMA (Jack w/socket contact) per MIL-STD-348 (output HP)

4390A2 Antenna	
P1	S909-13056-002 (AE3569W25-11P)
P2	BACC63BP16C24PN
J3	SMA (Jack w/socket contact) per MIL-STD-348
J4	SMA (Jack w/socket contact) per MIL-STD-348

4390A3 Power Supply	
J1	BACC63CC24-43SN
J2	BACC63CC14-7PN
J3	S909-13056-001 (AE3560W25-11S)

4390A4 Low Noise Block-Downconverter	
J1	SMA per MIL-C-39012/60
J2	TNC per MIL-C-39012/32
J3	BACC63BV8F3PN
Note: SMA and TNC connectors are configured per the LNB SCD (S909-32005).	



The system RF allocations are as identified in Figure 3-2.

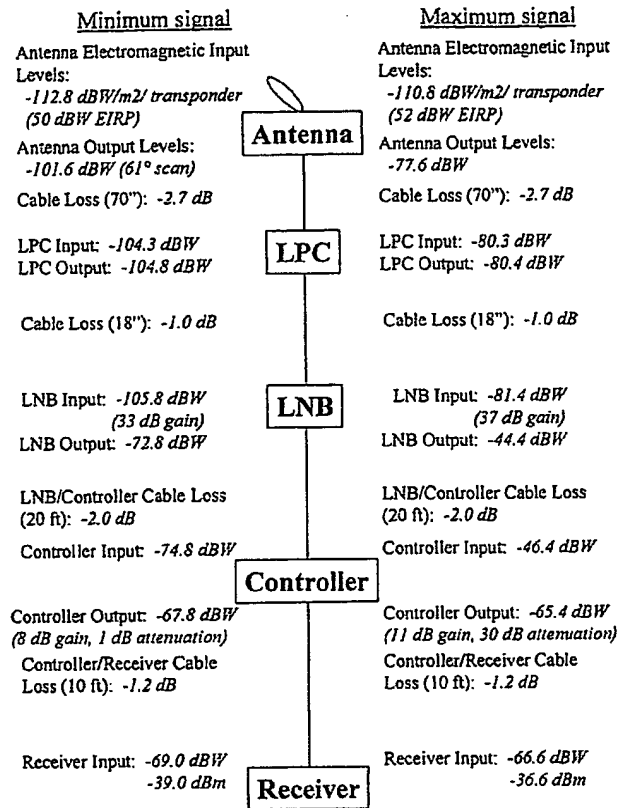


FIGURE 3-2 FAIRLINES SYSTEM RF ALLOCATIONS



3.1 Receive Antenna/LPC Interface

The receive antenna/LPC interface signal characteristics are defined in Table 3.1-1.

TABLE 3.1-1 RECEIVE ANTENNA/LNB SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector	S	Signal Name	Signal Characteristics	S	LPC (4390A36) Connector/ Pin Number
J3 (SMA)	√	BSS RF (LHCP)	RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J1-1 (SMA)
J4 (SMA)	√	BSS RF (RHCP)	(Same as BSS RF (LHCP))		J2-1 (SMA)

Note that each receive antenna to LPC cable connection includes a feedthrough shown on Figure 2-1. LHCP and RHCP cables are identical length (+/- 5 millimeter). Total length from antenna to LPC is 70" ± 1".

3.2 LNB/Controller Interface

The LNB/controller interface signal characteristics are defined in Table 3.2-1.

TABLE 3.2-1 LNB/CONTROLLER SIGNAL CHARACTERISTICS

LNB (4390A4) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A1) Connector
J2-2 (TNC)	√	LNB Downconverted BSS RF (VP)	RF Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J9 (TNC)
		LNB Band Select (VP)	Voltage: 10.0 to 12.0 Vdc: Convert 11.7-12.2 GHz Band 13.0 to 15.0 Vdc: Convert 12.2-12.7 GHz Band Current: ≤ 50 mA	√	
J2-1 (TNC)	√	LNB Downconverted BSS RF (HP)	(Same as LNB Downconverted BSS RF (VP))		J6 (TNC)
		LNB Band Select (HP)	(Same as LNB Band Select (VP))	√	



3.3 Receive Antenna/Controller Interface

The receive antenna/controller interface signal characteristics are defined in Table 3.3-1. The controller to antenna clock, data, and error lines are Boeing part number S280W502-3.

TABLE 3.3-1 RECEIVE ANTENNA/CONTROLLER SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A1) Connector/ Pin Number
P2-5		Data 2 +	RS-422	√	J3-6
P2-1		Data 2 -		√	J3-21
P2-2	-	Data 2 Shield	Data 2 + and Data 2 - Shield	-	J3-35
P2-4		Clock 1 +	RS-422	√	J3-7
P2-3		Clock 1 -		√	J3-22
P2-2	-	Clock 1 Shield	Clock 1 + and Clock 1 - Shield	-	J3-36
P2-11		Data 0 +	RS-422	√	J3-3
P2-23		Data 0 -		√	J3-18
P2-22	-	Data 0 Shield	Data 0 + and Data 0 - Shield	-	J3-32
P2-12		Data 1 +	RS-422	√	J3-2
P2-24		Data 1 -		√	J3-17
P2-22	-	Data 1 Shield	Data 1 + and Data 1 - Shield	-	J3-31
P2-17		Clock 0 +	RS-422	√	J3-4
P2-18		Clock 0 -		√	J3-19
P2-19	-	Clock 0 Shield	Clock 0 + and Clock 0 - Shield	-	J3-33
P2-6	√	Error 0 +	RS-422		J3-15
P2-7	√	Error 0 -			J3-30
P2-19	-	Error 0 Shield	Error 0 + and Error 0 - Shield	-	J3-44



3.4 Receive Antenna/Receive Power Supply Interface

The receive antenna/receive power supply interface signal characteristics are defined in Table 3.4-1.

TABLE 3.4-1 RECEIVE ANTENNA/RECEIVE POWER SUPPLY SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Receive Power Supply (4390A3) Connector/ Pin Number
P1-4		Overtemperature Power	+5±0.5 Vdc, ≤ 3 mA (SK Only) +7.5±1.0 Vdc, < 15 mA (4 mA nominal)	√	J3-4
P1-1	√	Overtemperature Signal	Overtemperature: +5±0.5 Vdc, ≥ 100KΩ Not Overtemperature: ≤ 0.1 Vdc, ≤ 150Ω		J3-1
P1-2		Overtemperature Return	Return	√	J3-2
P1-3	√	+6/+5 Vdc Sense +	Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc		J3-3
P1-5	√	+6/+5 Vdc Sense -	Current: ≤ 1 mA		J3-5
P1-6		+6/+5 Vdc Select	Short between Select and Return = +6 Vdc**		J3-6
P1-7		+6/+5 Vdc Select Return	Open between Select and Return = +5 Vdc		J3-7
P1-A		+6/+5 Vdc	Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc Current: 29 to 83 A	√	J3-A
P1-B	–	+6/+5 Vdc Return	Return	–	J3-B
P1-C		- 5 Vdc	Voltage: - 5 +5/-10% Vdc Current: 0.47 to 1.6 A	√	J3-C
P1-D	–	- 5 Vdc Return	Return	–	J3-D

*The receive power supply will provide +6 Vdc (instead of +5 Vdc) when a jumper is installed per Table 3.4-1.

**Note that the short or open of the +6 / +5 Vdc Select and Return lines is implemented in the receive antenna (anywhere between connector P1 and the antenna proper).



3.5 Receive Power Supply/Controller Interface

The receive power supply/controller interface signal characteristics are defined in Table 3.5-1.

TABLE 3.5-1 RECEIVE POWER SUPPLY/CONTROLLER SIGNAL CHARACTERISTICS

Receive Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A2) Connector/ Pin Number
J1-16	√	+ 19.5 Vdc Line 1	Voltage: +19.5±2.0 Vdc Current: 0.53 to 0.88 A (Total for both lines)		J1-1
J1-17	—	+ 19.5 Vdc Line 1 Return	Return	—	J1-2
J1-18	√	+ 19.5 Vdc Line 2	(Same as + 19.5 Vdc Line 1)		J1-9
J1-19	—	+ 19.5 Vdc Line 2 Return	Return	—	J1-10
J1-9	√	Status 0 + (LSB)	+5V Differential, 2 Bit Code + to - : +5V = 1, -5V = 0		J1-4
J1-8	√	Status 0 - (LSB)	Status codes, as Binary-Coded Decimal (BCD) (Status 0 is Least Significant Bit (LSB), Status 1 is Most Significant Bit (MSB)): <u>Decimal</u> <u>BCD</u> <u>Status</u> 0 00 Antenna Overtemperature 1 01 Controller/LNB Power Fault 2 10 Antenna Power Fault 3 11 No Faults		J1-5
J1-10	√	Status 1 + (MSB)			J1-11
J1-11	√	Status 1 - (MSB)			J1-12
	—	Chassis Ground	Ground	—	J1-13

3.6 Receive Power Supply/LNB Interface

The receive power supply/LNB interface signal characteristics are defined in Table 3.6-1.

TABLE 3.6-1 RECEIVE POWER SUPPLY/LNB SIGNAL CHARACTERISTICS

Receive Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	LNB (4390A4) Connector/ Pin Number
J1-20	√	+ 19.5 Vdc (LNB)	Voltage: +19.5±2.0 Vdc Current: 0.4 to 1.250 A		J3-1
J1-21	—	+ 19.5 Vdc Return	Return	—	J3-2
	—	Chassis Ground	Ground (For LNB Test Only)	—	J3-3
J1-BS	—	+ 19.5 Vdc Shield	Shield	—	J3-BS



- 3.7 Reserved
- 3.8 Reserved
- 3.9 Reserved
- 3.10 Reserved
- 3.11 LPC/LNB Interface

The LPC/LNB interface signal characteristics are defined in Table 3.11-1.

TABLE 3.11-1 LPC/LNB SIGNAL CHARACTERISTICS

LPC (4390A36) Connector	S	Signal Name	Signal Characteristics	S	LNB (4390A4) Connector/ Pin Number
J3 (SMA)	√	BSS RF (VP)	RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J1-1 (SMA)
J4 (SMA)	√	BSS RF (HP)	(Same as BSS RF (VP))		J1-2 (SMA)

VP and HP cables are identical length (+/- 5 millimeter). Total length is 18" \pm 1".



4. EXTERNAL INTERFACES

The signal characteristics for each of the external interface connections are contained in the sections identified on Figure 4-1.

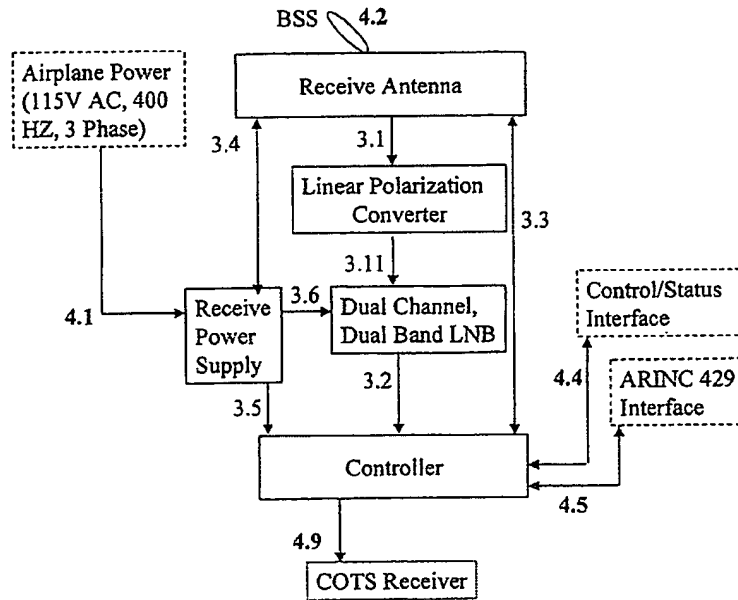


FIGURE 4-1 EXTERNAL INTERFACE SECTIONS



4.1 Airplane Power (115V AC, 400 Hz) Interface

The airplane power (115V AC, 400 Hz) interface signal characteristics are defined in Table 4.1-1.

TABLE 4.1-1 AIRPLANE POWER SIGNAL CHARACTERISTICS

Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Airplane Connector/ Pin Number
J2-1		Phase A	115V AC, 400 Hz	√	P2-1
J2-3		Phase B	115V AC, 400 Hz (120 degree phase displacement from Phase A)	√	P2-3
J2-5		Phase C	115V AC, 400 Hz (240 degree phase displacement from Phase A)	√	P2-5
J2-7	–	Neutral	Return	–	P2-7
J2-6	–	Chassis Ground	Safety Ground	–	P2-6

4.2 Broadcast Satellite Services Interface

The broadcast satellite services interface signal characteristics are defined in Table 4.2-1.

TABLE 4.2-1 BROADCAST SATELLITE SERVICES SIGNAL CHARACTERISTICS

BSS Satellite	S	Signal Name	Signal Characteristics	S	Receive Antenna (4390A2)
Downlink Transmit Antenna	√	BSS Input	Electromagnetic Wave Frequency Range: 11.7 to 12.7 GHz Instantaneous Bandwidth: 500 MHz Flux: see figure 3-2[Flux(dBW/m ²) =EIRP(dBW) - 20log(Path (km)) - 71.0, where "Path" is satellite-antenna distance.] Polarization: Horizontal and Vertical		Phased Array



4.3 Reserved

4.4 Control/Status Interface

The control/status interface signal characteristics are defined in Table 4.4-1.

TABLE 4.4-1 CONTROL/STATUS INTERFACE SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Connector/ Pin Number
J2-4		Control/Status RX	RS-232, asynchronous 8 data bits, 1 start bit, 1 stop bit, no parity 19200 baud	√	P2-4
J2-5	√	Control/Status TX	(Same as Control/Status RX)		P2-5
J2-12	–	Control/Status Signal Return	Return	–	P2-12
J2-13	–	Control/Status Signal Shield	Shield	–	P2-13
J2-6		Shop Mode 0	TTL Levels (inputs to controller) Open = 0, Ground = 1		P2-6
J2-14		Shop Mode 1			P2-14
J2-1	√	Shop Mode RX	(Same as Control/Status RX)		P2-1
J2-2		Shop Mode TX	(Same as Control/Status RX)	√	P2-2
J2-9	–	Shop Mode Return	Return	–	P2-9
J2-8	√	485 Port 2 + (Spare)	RS-485		Not Connected
J2-7	√	485 Port 2 - (Spare)			Not Connected
J2-15	–	485 Port 2 Shield (Spare)	485 Port 2 + and 485 Port 2 - Shield	–	Not Connected

4.5 ARINC 429 Interface

The ARINC 429 interface signal characteristics are defined in Table 4.5-1.

TABLE 4.5-1 ARINC 429 SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Connector/ Pin Number
J4-2		ARINC 429 RX A	High = +6.5 to +13.0 VDC differential Low = -6.5 to -13.0 VDC differential Null = -2.5 to +2.5 VDC differential	√	P4-2
J4-3		ARINC 429 RX B		√	P4-3
J4-7	–	ARINC 429 Shield		–	P4-7



- 4.6 Reserved
- 4.7 Reserved
- 4.8 Reserved
- 4.9 COTS Receiver

The Controller/COTS Receiver interface signal characteristics are defined in Table 4.8-1.

TABLE 4.8-1 CONTROLLER/COTS RECEIVER SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	COTS Receiver Connector / Pin Number
J8 (TNC)	√	Downconverted BSS RF (VP)	Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 $E_b/N_0 \geq 5.8$ dB Line Impedance: 50 Ω		Per Receiver
J7 (TNC)	√	Downconverted BSS RF (HP)	(Same as Downconverted BSS RF (VP))		Not connected



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